University of Nebraska - Lincoln

DigitalCommons@University of Nebraska - Lincoln

Historical Materials from University of Nebraska-Lincoln Extension

Extension

1998

EC98-748 Farm*A*Syst Nebraska's System for Assessing Water Contamination Risk Worksheet 2: Site Evaluation

Robert Grisso
University of Nebraska at Lincoln

DeLynn Hay
University of Nebraska-Lincoln, dhay1@unl.edu

Paul J. Jasa
University of Nebraska at Lincoln, pjasa1@unl.edu

Richard K. Koelsch
University of Nebraska - Lincoln, rkoelsch1@unl.edu

Sharon Skipton
University of Nebraska–Lincoln, sskipton1@unl.edu

See next page for additional authors

Authors
Robert Grisso, DeLynn Hay, Paul J. Jasa, Richard K. Koelsch, Sharon Skipton, and Wayne Woldt

Farm•A•Syst

WORKSHEET 2

Nebraska's System for Assessing Water Contamination Risk

Site Evaluation

Why is the site evaluation important?

The effect of farm, ranch or homesite practices on groundwater depends in part on the physical characteristics of your site: soil type, subsurface characteristics and depth to groundwater. That's why evaluating the soils and geologic characteristics of your site is such an important step in protecting the groundwater you drink. This evaluation focuses primarily on the farmstead or homesite and risk to groundwater, but, to a limited extent, also addresses surface water. The worksheet can be applied to land beyond the farmstead or homesite, but the variation in soils and geologic materials would have to be considered. The worksheet uses considerable generalization to characterize risk to water quality. More detailed information would allow a better assessment. You need to recognize that there may be exceptions to the risk levels identified.

How do soils affect the potential for groundwater contamination?

Soil characteristics are very important in determining whether a contaminant breaks down to harmless compounds or leaches into groundwater. Because most breakdown occurs in the soil, there is a greater potential for groundwater contamination in areas where contaminants are able to move quickly through the soil.

- Sandy soils have large "pore" spaces between individual particles, and the particles provide relatively little surface area for "sorption," or physical attachment of most contaminants. Large amounts of rainfall can move through these soils, and dissolved contaminants can move rapidly down through the soil and into groundwater.

- Clay soils, on the other hand, are made up of extremely small particles that slow the movement of water and dissolved contaminants through the soil. Contaminants also "stick" more tightly to clay surfaces.

While held securely to soil particles, contaminants are broken down by bacteria and other soil organisms and by chemical reactions with minerals and natural chemicals in the soil. Most of this chemical and biological breakdown takes place in the loose, cultivated surface layers, where the soil tends to be warm, moist, high in organic matter and well aerated.

Finally, soil organic matter is important in holding contaminants. Soils high in organic matter provide an excellent environment for chemical and biological breakdown of most contaminants—before they reach the groundwater. Organic matter also provides an important site for contaminants to absorb, or stick to, soil particles.

The natural purification capability of the soil is limited. Under certain conditions, such as heavy rainfall, irrigation,

Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture.
Elbert C. Dickey, Interim Director of Cooperative Extension, University of Nebraska, Institute of Agriculture and Natural Resources.

and chemical spills, the soil's purification capacity may be exceeded, allowing leaching to occur. In such cases, the subsurface geologic material and the distance a contaminant must travel to groundwater are important factors in determining whether a contaminant actually reaches the groundwater.

The surface soil texture is used as one of the site characteristics.

How do subsurface and geologic materials affect the potential for groundwater contamination?

Nebraska soils are formed in and over a variety of geologic parent materials. Upland soils in eastern, central and south-central Nebraska formed mainly in windblown silt (loess). In parts of southeastern Nebraska where the loess has been eroded, till is the soil parent material. Windblown sand is the dominant parent material in the Sandhills, and soils in the Panhandle and southwestern Nebraska formed in a mixture of windblown sandy and loamy material and weathered bedrock. Soils on stream terraces formed in windblown and water deposited (alluvial) materials. Soils on bottom lands formed in alluvial sand, silt and clay. Thus, your geographic location in Nebraska can have a significant impact on site evaluation and your potential for pollution leaching to groundwater.

Depth to groundwater is important primarily because it determines not only the depth of material through which a contaminant must travel before reaching an aquifer, but also the time during which a contaminant is in contact with the material. The type of soil or geologic material will have a significant impact on how fast contaminants will move from the land surface to groundwater.

Bedrock geology influences groundwater pollution when the water table is below the bedrock surface. Sedimentary rocks have a wide range of permeability—from permeable fractured siltstone to impermeable well-cemented sandstone. Movement of pollutants in fractured limestone or dolomite is unpredictable, and pollutants can readily spread over large areas. Where bedrock material contains significant cracks and fractures, the depth and characteristics of soil and shallow geologic deposits largely determine the potential for groundwater contamination.

What's involved in completing this worksheet?

We have provided a way to evaluate your site for groundwater and surface water contamination potential, or vulnerability. Part 1 is an evaluation of groundwater vulnerability. Part 2 is an evaluation of surface water vulnerability. A copy of your county's soil survey report will help you complete parts 1 and 2 of this worksheet. The report is available at most local offices of the Natural Resources Conservation Service, Natural Resources District, or University of Nebraska Cooperative Extension. Part 3 is an optional site diagram.

A word of caution:

As with the results of the other assessment worksheets, use the rankings from this worksheet cautiously. These rankings provide a general indication of vulnerability and are not a precise, exact ranking. Many factors affect whether or not a contaminant will leach into groundwater. There is no guarantee that a "low-risk" site will be uncontaminated—or that groundwater will become contaminated at a "high-risk" site. The type of contaminant involved, how you handle and store potential contaminants (such as pesticides and manure), the location and maintenance of your well, and many other factors can affect the potential for groundwater contamination. Farm*A*Syst should result in a good, first estimate of your situation.

Glossary

These definitions may help clarify some of the terms used in *Worksheet 2*.

Organic matter: Matter containing compounds of plant or animal origin, measured by organic carbon content.

Sediment: Waterborne or windborne particles.

Sedimentary: Rock formed from compaction and / or cementation of sediment.

Soil texture: The relative proportions of the various soil separates (sand, silt, and clay) in a soil. Described by such terms as sandy, loam, and silty clay.

Till: Unstratified glacial drift deposited by ice and consisting of clay, silt, sand, gravel, and boulders intermingled in any proportion.

Site's Vulnerability to Pollution Reaching Ground or Surface Water

Part 1. Vulnerability to Pollution Reaching GROUNDWATER

Surface texture	**Ranking**
Loam, silt loam, sandy clay loam, silt	1
Clay, sandy clay, silty clay, clay loam, silty clay loam	2
Loamy fine sand, loamy very fine sand, fine sandy loam, very fine sandy loam	3
Sand, loamy sand, sandy loam, organic materials and all textural classes with coarse fragment class modifiers (such as "gravelly loam")	4
Your ranking	

Subsurface texture and depth to groundwater
(select ONE score from this chart)

Depth to Groundwater	Texture of subsurface* Fine textured (Clays)	Medium textured (Silts)	Coarse textured (Sands / Gravels)	
1. Greater than 50 feet	1	1	2	
2. 31 to 50 feet	2	2	3	
3. 11 to 30 feet	3	3	4	
4. 0 to 10 feet	3	4	4	
Your ranking				

*For a fractured bedrock at or above the water table you should use a ranking of 4.

Finding your site's vulnerability to pollution reaching groundwater

Surface texture ranking ________
\+ Subsurface texture and depth to groundwater ranking ________

= ________ ÷ 2 = ______ **Groundwater Vulnerability Score**

If your groundwater vulnerability score is:
- 1 to 1.4: your site has a LOW VULNERABILITY to pollution reaching groundwater
- 1.5 to 2.4: your site has MODERATE-LOW VULNERABILITY to pollution reaching groundwater
- 2.5 to 3.4: your site has a HIGH-MODERATE VULNERABILITY to pollution reaching groundwater
- 3.5 to 4.0: your site has a HIGH VULNERABILITY to pollution reaching groundwater

If the soils or subsurface geology vary at a site or within a field, you should determine groundwater vulnerability for each area with similar characteristics.

Transfer your groundwater vulnerability score to each individual worksheet completed.

Caution: if your site is vulnerable to pollution reaching groundwater, study your individual worksheet risk scores carefully. Consider taking action in regard to worksheet scores of 2 or 3 in addition to scores of 4 when practices could be impacted by site vulnerability.

Part 2: Vulnerability to Pollution Reaching SURFACE WATER

Texture of surface	**Ranking**
Sand, loamy sand, sandy loam, organic materials and all textural classes with coarse fragment class modifiers (such as “gravelly loam”)	1
Loamy fine sand, loamy very fine sand, fine sandy loam, very fine sandy loam	2
Loam, silt loam, sandy clay loam, silt	3
Clay, sandy clay, silty clay, clay loam, silty clay loam	4
Your ranking	

Topography, slope of site from pollution source toward surface water	**Ranking**
0 - 1% slope	1
2 - 3% slope	2
4 - 6% slope	3
Over 6% slope	4
Your ranking	

Distance from pollution source to nearest surface water*	**Ranking**
Greater than 500 feet	1
200 - 500 feet	2
100 - 199 feet	3
Less than 100 feet	4
Your ranking	

*Surface water includes continuous flowing and intermittent streams, ponds, lakes, wetlands, and field drainways that flow directly to surface water bodies.

Finding your sites’s vulnerability to pollution reaching surface water

Texture of surface ranking ________
\+ Slope of site ranking ________
\+ Distance from pollution source ranking ________

= ________ ÷ 3 = ______ **Surface Water Vulnerability Score**

If your surface water vulnerability score is:
- 1 to 1.4: your site has a LOW VULNERABILITY to pollution reaching surface water
- 1.5 to 2.4: your site has MODERATE-LOW VULNERABILITY to pollution reaching surface water
- 2.5 to 3.4: your site has a HIGH-MODERATE VULNERABILITY to pollution reaching surface water
- 3.5 to 4.0: your site has a HIGH VULNERABILITY to pollution reaching surface water

Your surface water vulnerability may vary for individual pollution sources or sites because of varying soils and slopes. The distance from the pollution source to the nearest surface water will likely change for each source.

Transfer your surface water vulnerability score to each individual worksheet completed.

Caution: if your site is vulnerable to pollution reaching surface water, study your individual worksheet risk scores carefully. Consider taking action in regard to worksheet scores of 2 or 3 in addition to scores of 4 when practices could be impacted by site vulnerability.

Diagramming

Sketching a diagram of your site can provide useful information to help you understand how the physical layout and site characteristics may contribute to—or lessen—the effects of possible contaminants reaching your drinking water.

The diagram can show the location of wells, septic drain fields, manure storage areas, direction of groundwater flow, surface water locations and flow patterns, buildings, and other activities that may contribute potential contaminants. Along with the soil and subsurface evaluations, the diagram will help point out aspects of your site that may present a hazard to your drinking water.

Begin by looking at the sample diagram.

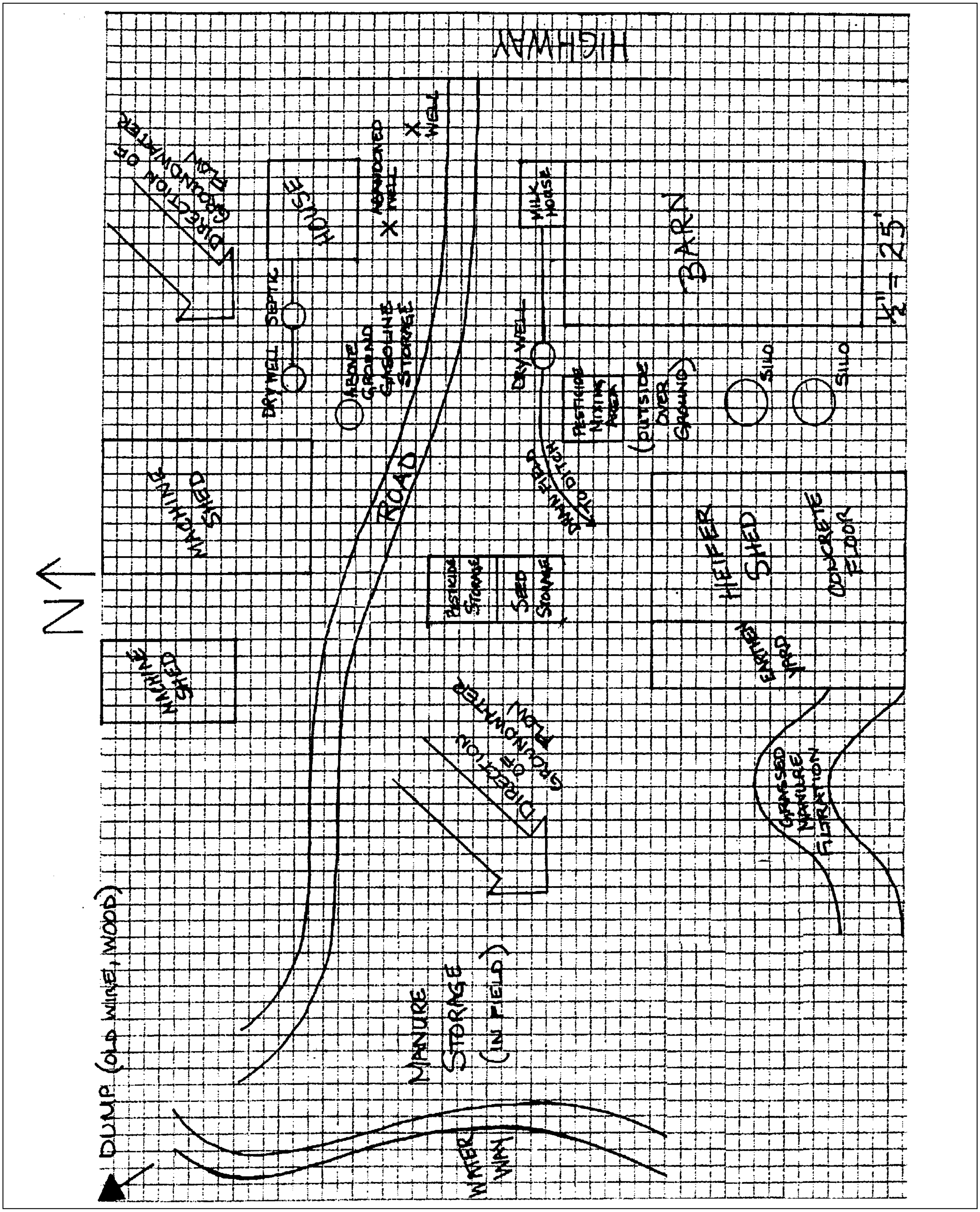
Then diagram your site on the blank grid provided. Include all of the following that apply to your site:

- all buildings and other structures (home, barn, machine shed shop)
- wells (active and unused)
- septic system (tank, dry well, absorption field, and/or ditch)
- cowyard/livestock yard
- manure storage (temporary and permanent)
- underground petroleum tank
- above ground petroleum storage tank
- pesticide and fertilizer storage, handling, and mixing areas
- silage storage
- milkhouse waste disposal system (tank, field, and/or ditch)
- waste dumps
- vehicle maintenance areas
- liquid disposal areas
- tiles, surface intakes, and open ditches

You can use the same diagram to indicate surface water (ponds and streams), direction of land slope, groundwater flow direction, and the different soil types found around your site. Generally, groundwater follows surface topography and moves downhill toward surface water. Your NRD or the UNL Conservation and Survey Division may be able to provide more specific information on groundwater flow direction.

Use your diagram to note which activities or structures on your site have a greater likelihood of allowing contaminants to reach groundwater. This information should help prepare you to make better decisions about your farm, ranch or homesite activities and structures and how they might be affecting your drinking water.

Sample Site Diagram



Your Site Diagram

Partial funding for materials, adaptation, and development was provided by the U.S. EPA, Region VII (Pollution Prevention Incentives for States and Nonpoint Source Programs) and USDA (Central Blue Valley Water Quality HUA). This project was coordinated at the Department of Biological Systems Engineering, Cooperative Extension Division, Institute of Agriculture and Natural Resources, University of Nebraska-Lincoln.

Nebraska Farm*A*Syst team members included: Robert Grisso, Extension Engineer, Ag Machinery; DeLynn Hay, Extension Specialist, Water Resources and Irrigation; Paul Jasa, Extension Engineer; Richard Koelsch, Livestock Bioenvironmental Engineer; Sharon Skipton, Extension Educator; and Wayne Woldt, Extension Bioenvironmental Engineer. Editorial assistance was provided by Nick Partsch and Sharon Skipton. Technical reviews were provided by: Dick Ehrman, Program Specialist, Nebraska Department of Environmental Quality, Ed Harvey, Research Hydrogeologist, Mark Kuzila, Research Soil Scientist, and Marty Link, Unit Supervisor, Nebraska Department of Environmental Quality.

The views expressed in this publication are those of the author and do not necessarily reflect the views of either the technical reviewers or the agencies they represent.

Adapted for Nebraska from material prepared for the Wisconsin and Minnesota Farm*A*Syst programs written by Kim Cates, Wisconsin Geological and Natural History Survey, and Fred Madison, University of Wisconsin.

Printed on recycled paper.

NOTES